

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the US Patent Application of

Junichi SATO

Serial No. 09/161,520

Filed: **September 29, 1998**

For: CHEMICAL-MECHANICAL
POLISHING PROCESS

Group Art Unit: 1763

Examiner: R. Bueker

APPEAL BRIEF

Commissioner for Patents
BOX AF
Washington, D.C. 20231

Sir:

This is an Appeal Brief in response to the final rejection of the Examiner dated January 23, 2002 (Paper No. 22). Each of the topics required by 37 C.F.R. § 1.192 is presented in this Brief and is labeled appropriately.

I. Real Party in Interest

Sony Corporation of Tokyo, Japan ("Sony") is the real party in interest of the present application. An assignment of all rights in the present application to Sony was executed by the inventors and recorded by the U.S. Patent and Trademark Office at **reel 9510, frame 0496**.

II. Related Appeals and Interferences

There are no appeals or interferences related to the present application of which the Appellant is aware.

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III. Status of Claims

On May 23, 2002, Appellant appealed from the final rejection of claims 12 to 14, 16 to 20, 22, and 24 to 27. The application as filed on September 29, 1998 originally included claims 12 to 14, and 16 to 20. No claims were withdrawn from consideration pursuant to a restriction requirement. Claim 21 was added on February 23, 1999. Claims 12 and 16 were amended and claims 22 to 27 were added on June 24, 1999. Claim 23 was canceled and incorporated verbatim into claim 22 on March 30, 2001. Claim 21 was canceled on November 13, 2001, and claims 12, 22, and 25 to 26 were amended at that time. An amendment filed herewith amends claims 12 and 16.

IV. Status of Amendments

Following the issuance of the final rejection in Paper No. 9, Appellant filed a Response After Final Rejection on June 28, 2000 making no changes to the claims. In an Advisory Action mailed on June 27, 2000 the Examiner maintained the rejections set forth in Paper No. 9. Appellant filed a Notice of Appeal on July 28, 2000, and an Appeal Brief was filed September 27, 2000.

The Examiner reopened prosecution of the application, issuing a non-final Office Action on November 16, 2000. However, the Examiner did not cite a new ground of rejection in compliance with 37 C.F.R. § 1.193 or M.P.E.P. § 1208.01.

Instead, the November 16, 2000 Office Action merely withdrew rejections of two of the pending claims, and reformulated the previous rejections only using previously cited prior art. A Supplemental Appeal Brief was filed on March 30, 2001 to have the appeal reinstated.

The Examiner reopened prosecution a second time, issuing a non-final Office Action on August 10, 2001. An amendment was filed in response to the Action on November 13, 2001. The Examiner issued Paper No. 22 on January 23, 2002. An After Final Amendment is filed with this Appeal Brief amending claims 12 and 16. The claims in the Appendix represent the state of the claims assuming that the Amendment filed herewith is entered by the Examiner.

V. Summary of the Invention

The first embodiment of the present invention is a chemical-mechanical polishing process for planarizing one or more thin films such as an interlayer dielectric film (104 in Fig. 1A) formed on a substrate (5 in Fig. 3) such as a semiconductor wafer. The chemical-mechanical polishing process is performed using a slurry that contains abrasive particles where all of the abrasive particles consist of boehmite in a basic atmosphere (page 13, lines 11 to 15). The boehmite particles in the slurry are preferably suspended in a solution containing KOH, water, and an alcohol (page 13, lines

11 to 15). According to the first embodiment, the particles of boehmite are formed by dipping particles of Al in hot water (page 13, lines 15 to 17). In addition, it is advantageous to add sodium aluminate to the hot water (page 13, lines 16 to 17). The hot water is typically about 80 °C (page 13, lines 16 to 17).

The second embodiment of the invention is a chemical-mechanical polishing process as set forth in the first embodiment, with the exception of the feature that all of the abrasive particles in the slurry consist essentially of boehmite, and further including the step of removing any residual slurry and contamination by spin cleaning. The spin cleaning is performed using chemicals that include a solution containing NH_4 , H_2O_2 , and H_2O (page 13, lines 20 to 23). Following this step, a hydrofluoric acid solution is applied to the thus cleaned surface (page 13, line 23 to page 14, line 1). Finally, the substrate surface is rinsed with pure water (page 14, lines 1 to 2).

A third embodiment of the invention is a polishing process which includes the step of forming abrasive boehmite particles by dipping particles of aluminum in heated water (page 13, lines 15 to 17) with sodium aluminate added thereto (page 13, lines 16 to 17). Then, a slurry containing the abrasive boehmite particles is created, and at least one film formed on a substrate is planarized by employing a chemical-mechanical

polishing process using the slurry.

VI. References of Record

In the rejection of Paper No. 22, the Examiner relied upon the following prior art:

- (1) U.S. Patent No. 5,693,239, issued to Wang et al. ("Wang");
- (2) U.S. Patent No. 4,956,313, issued to Cote et al. ("Cote");
- (3) U.S. Patent No. 5,723,019, issued to Krussell et al. ("Krussell");
- (4) K. Wefers et al., Oxides and Hydroxides of Aluminum, Alcoa Technical Paper No. 19, Revised, (Alcoa Labs. 1997) ("Wefers");
- (5) U.S. Patent No. 5,478,436 issued to Winebarger et al. ("Winebarger"); and
- (6) U.S. Patent No. 5,366,542 issued to Yamada et al. ("Yamada").

VII. Issues

In light of the rejection in Paper No. 22, the issues presented on this appeal are:

- (1) whether claims 12 to 14 are obvious, as these claims stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Cote in view of Wang;

(2) whether claim 13 is obvious, as this claims stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Cote in view of Wang and Wefers;

(3) whether claims 16 to 20, and 25 are obvious, as these claims stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Wang in view of Krussell and Winebarger;

(4) whether claim 19 is obvious, as this claim stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Wang in view of Krussell, Winebarger, and Wefers;

(5) whether claims 12 to 14 are either not novel or obvious, as these claims are rejected under either of 35 U.S.C. §§ 102, 103 as being either anticipated by, or obvious over Yamada;

(6) whether claim 13 is obvious, as this claim stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamada in view of Wefers; and

(7) whether claims 14, 20, 22 and 24 to 27 describe subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention, as these claims are rejected under 35 U.S.C. § 112, first paragraph.

VIII. Grouping of Claims

Claims 12 to 13 stand or fall together. Claim 14 stands or falls alone. Claims 16 to 19 stand or fall together. Claim 20 stands or falls alone. Claims 20, 22 and 24 to 27 stand or fall together. The reasoning for the grouping of the claims is evident in light of the following arguments.

IX. Arguments

A. Rejections Under 35 U.S.C. §§ 102(b), 103(a)

1. Claims 12 to 14

Claim 12 recites that the chemical-mechanical polishing is performed using a basic slurry containing abrasive particles with all of the abrasive particles consisting of boehmite, and it is clear that Yamada fails to teach or suggest this limitation. Yamada teaches a slurry that includes alpha alumina, and may optionally have boehmite added as an additional component. Nowhere in Yamada is there any teaching or suggestion that all of the abrasive particles in the slurry consist of boehmite. Consequently, the rejections of claims 12 to 14 under 35 U.S.C. § 102(b) should not be affirmed by the Board.

Regarding the obviousness rejections based on Yamada, Yamada teaches at column 3, lines 33 to 42 that boehmite is an optional addition to a composition that includes alumina as a

primary polishing compound. At column 3, lines 24 to 32, Yamada explains that the boehmite serves to accentuate the polishing properties of the alumina, and warns that too much boehmite (over 20% by weight) actually impairs the polishing composition. From this, it is clear that a person of ordinary skill in the art would read Yamada and be led away from a polishing process that involves a composition where all of the abrasive particles consist of boehmite. Consequently, the rejections under 35 U.S.C. § 103 based upon Yamada should not be affirmed by the Board.

Regarding the obviousness rejections based on Cote and Wang, neither of these references teaches or suggests the above-discussed limitation of claim 12 where all of the abrasive particles consist of boehmite. Cote discloses an alumina slurry that can be alkaline, and fails to mention the use of boehmite in any manner. Wang discloses slurries that include submicron alpha-alumina particles as an essential component. The Wang polishing process that utilizes a slurry where the solids in the slurry being employed are 1 to 50 percent alpha-alumina, with the remainder of the solids being of a second, substantially less abrasive phase that may include aluminum oxide materials such as boehmite. Consequently, each and every limitation recited in claim 12 (and therefore 13 to 14) is neither taught nor suggested by the combination of Cote and Wang.

It is further taught in Wang that when tests were performed where submicron abrasive solids included mixtures of such compounds as alpha-alumina, boehmite, and gamma-aluminum oxide, as the solid concentration dropped below 1% alpha-alumina the polishing properties became substantially worse. Based on these teachings, it is clear that a person of ordinary skill in the art would not find it obvious to utilize a polishing slurry where all the abrasive particles consist of boehmite. For these reasons, it is respectfully submitted that the rejections of claims 12 to 14 under 35 U.S.C. § 103 based upon Cote and Wang should not be affirmed by the Board.

Claim 13 is further rejected as being unpatentable over Cote and Wang, or Yamada, in view of Wefers. Although Wefers allegedly teaches that boehmite can be formed by treating aluminum with hot water, the reference clearly fails to teach or suggest any type of chemical-mechanical polishing process. Consequently, Wefers fails to compensate for the deficiencies of Cote and Wang in a manner that would teach or suggest to a person of ordinary skill in the art that such a process would be performed using a slurry of abrasive particles consisting of boehmite. Therefore, the rejection of claim 13 should be withdrawn for this additional reason.

2. Claims 16 to 20

Independent claim 16 includes the limitation that in a polishing process that utilizes a slurry, all of the abrasive particles in the slurry consist essentially of boehmite. Neither Krusell nor Winebarger discloses the claimed slurry consisting essentially of boehmite, but are applied against the claims for their teachings directed to rinsing agents for post-polishing cleaning steps. As discussed above, Wang discloses polishing processes that incorporate slurries containing boehmite particles, but the Wang slurries do not contain abrasive particles that consist essentially of boehmite. Rather, Wang slurries include submicron alpha-alumina particles as an essential and inventive component and at a minimum concentration of 1%, in addition to substantially less abrasive particles that may include aluminum oxide materials such as boehmite.

The Examiner asserts that additional abrasive particles within the slurry would not materially change the characteristic of the present invention. Yet, to formulate a slurry where all the polishing solid particles consist essentially of boehmite, and then to add alpha-alumina, which is substantially more abrasive than boehmite, would intuitively change the slurry to become substantially more abrasive. This is particularly clear in light of the teachings of Wang that as little as 1% of alpha-alumina

produces a substantially increased polishing rate and "unexpectedly" favorable selectivity rates than where there is less than 1% alpha-alumina (see col. 3, lines 24 to 37). It is clear that making the slurry substantially more abrasive by adding as little as 1% alpha-alumina would change the slurry of the present invention in a material manner. Consequently, it is clear that the Wang slurry does not consist essentially of boehmite as claimed in claim 16, and that a person of ordinary skill in the art would not arrive at the present invention as claimed in claim 16 from reading Wang alone or in view of Krusell or Winebarger. Accordingly, the "consisting essentially of" limitation of claims 16 to 20 is not taught or suggested by any of the prior art references of record, and the rejection of claims 16 to 20 under 35 U.S.C. § 103(a) should not be affirmed by the Board.

3. Claims 22, and 24 to 27

Claims 22, and 24 to 27 are not rejected based upon any prior art reference, under either of 35 U.S.C. §§ 102, 103.

B. Rejections Under 35 U.S.C. § 112, First Paragraph

Regarding claims 14, 20, 22, and 24 to 27, clearly, a person of ordinary skill in the art would recognize that the addition of another aluminum compound to a composition where abrasive boehmite (AlOOH) particles are being formed would

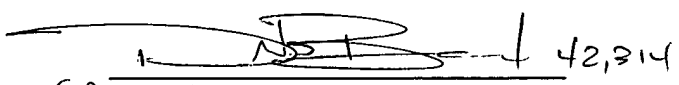
affect the solubility of the boehmite. Further, the total abrasiveness of the aluminum-type particles formed in the solution could be affected by the presence of sodium aluminate. Further, it would clearly not constitute undue experimentation for a person of ordinary skill in the art to determine by trial what particular amount of sodium aluminate would be most effective to obtain desired characteristics such as total aluminum particle abrasiveness and solubility of the boehmite. Consequently, these enablement rejections should not be sustained by the Board.

X. Conclusion

In view of the foregoing, it is submitted that the final rejection of claims 12 to 14, 16 to 20, 22, and 24 to 27 should not be sustained. Therefore, a reversal of the Final Rejection in Paper No. 22 is respectfully requested.

Respectfully submitted,

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APPENDIX AClaims on Appeal

12. A chemical-mechanical polishing process for planarizing one or more thin films formed on a substrate, wherein the chemical-mechanical polishing is performed using an abrasive particles basic slurry, all of said abrasive particles consisting of boehmite.

13. A chemical-mechanical polishing process according to claim 12, wherein the particles of boehmite are formed by dipping of particles of Al in hot water.

14. A chemical-mechanical polishing process according to claim 13, wherein said hot water is added with sodium aluminate.

16. (amended) A chemical-mechanical polishing process for planarizing one or more films formed on a substrate, wherein said thin films are subjected to chemical-mechanical polishing using an abrasive particles slurry, all of said abrasive particles consisting essentially of boehmite, and the residual slurry and contamination are removed by spin cleaning.

17. A chemical-mechanical polishing process according to claim 16, wherein said spin cleaning is performed using

chemicals comprising a solution containing NH_4OH , H_2O_2 , and H_2O , followed by a hydrofluoric acid solution.

18. A chemical-mechanical polishing process according to claim 17, wherein after spin cleaning using said chemicals, said substrate is rinsed with pure water.

19. A chemical-mechanical polishing process according to claim 16, wherein the abrasive particles of boehmite are formed by dipping of particles of Al in a hot water.

20. A chemical-mechanical polishing process according to claim 19, wherein said hot water is added with sodium aluminate.

22. A polishing process which comprises the steps of:
forming abrasive boehmite particles by dipping particles of aluminum in heated water with sodium aluminate added thereto;

creating a slurry containing said abrasive boehmite particles; and

planarizing at least one film formed on a substrate by employing a chemical-mechanical polishing process using said slurry.

24. A polishing process according to claim 22, wherein said heated water is about 80 °C.

25. A polishing process according to claim 22, wherein said slurry used in said chemical-mechanical polishing process is a basic slurry.

26. A polishing process according to claim 25, wherein said step of creating a slurry comprises suspending said boehmite particles in a solution containing KOH, water, and an alcohol.

27. A polishing process according to claim 22, wherein said film is an interlayer dielectric film.